

# STO-2: Support for 4th Year Operations, Recovery, and Science

Completed Technology Project (2017 - 2017)



## Project Introduction

The Stratospheric TeraHertz Observatory was ready for its second Antarctic flight (STO-2) in the 2015-2016 austral summer. However, due to the late establishment of the stratospheric anti-cyclone and poor surface conditions, STO-2 was unable to launch. The decision was made to winter-over the STO-2 payload in its hangar for launch during the 2016-2017 Antarctic campaign. Funds to cover preparations and deployment of key members of the instrument team in support of the campaign are being provided by NASA under the existing grant. However, these funds are only sufficient to cover expenses up to December 31st, 2016. Here, we request resources for calendar year 2017 to support mission operations, payload recovery, and science operations. These elements will enable the team to deliver fully on STO-2's science mission, and maximize NASA's demonstrated investment in STO-2's success. STO-2 addresses a key problem in modern astrophysics: understanding the Life Cycle of the Interstellar Medium (ISM). STO-2 will survey approximately  $\frac{1}{4}$  of the Southern Galactic Plane in the dominant interstellar cooling line [CII] ( $158 \mu\text{m}$ ) and the important star formation tracer [NII] ( $205 \mu\text{m}$ ). In addition, STO-2 will perform path finding observations of the  $63 \mu\text{m}$  [OI] line toward selected regions. With 1 arcminute angular resolution, STO-2 will spatially resolve atomic, ionic and molecular clouds out to 10 kpc. The STO-2 survey will be conducted at unparalleled sensitivity levels. STO-2 will uniquely probe the pivotal formative and disruptive stages in the life cycle of interstellar clouds and the relationship between global star formation rates and the properties of the ISM. Combined with previous HI and CO surveys, STO-2 will create 3-dimensional maps of the structure, dynamics, turbulence, energy balance, and pressure of the Milky Way's ISM, as well as the star formation rate. Once we gain an understanding of the relationship between ISM properties and star formation in the Milky Way, we can better interpret observations of nearby galaxies and the distant universe. The mission goals for these surveys are to:

- Determine the life cycle of Galactic interstellar gas.
- Study the creation and disruption of star-forming clouds in the Galaxy.
- Determine the parameters that affect the star formation rate in the galaxy.
- Provide templates for star formation and stellar/interstellar feedback in other galaxies.

STO-2 reuses the 80cm telescope and many subsystems from STO-1. It also reuses the gondola developed by APL for the BOPPS and BRRISON comet missions. For the STO-2 flight, STO-1's high spectral resolution ( $<1 \text{ km/s}$ ) heterodyne receiver system was upgraded for extended cryogenic lifetime, enhanced sensitivity, and greater reliability. The flight receiver has five cryogenic HEB mixers; two optimized for the  $158 \mu\text{m}$  [CII] line, two for the  $205 \mu\text{m}$  [NII] line, and one for the  $63 \mu\text{m}$  [OI] line. STO is capable of detecting every giant molecular cloud, every HII region of significance, and every diffuse HI cloud with ( $AV \geq 0.4$ ) within its survey region.



STO-2: Support for 4th Year Operations, Recovery, and Science

## Table of Contents

Project Introduction	1
Organizational Responsibility	1
Primary U.S. Work Locations and Key Partners	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destination	3

## Organizational Responsibility

### Responsible Mission Directorate:

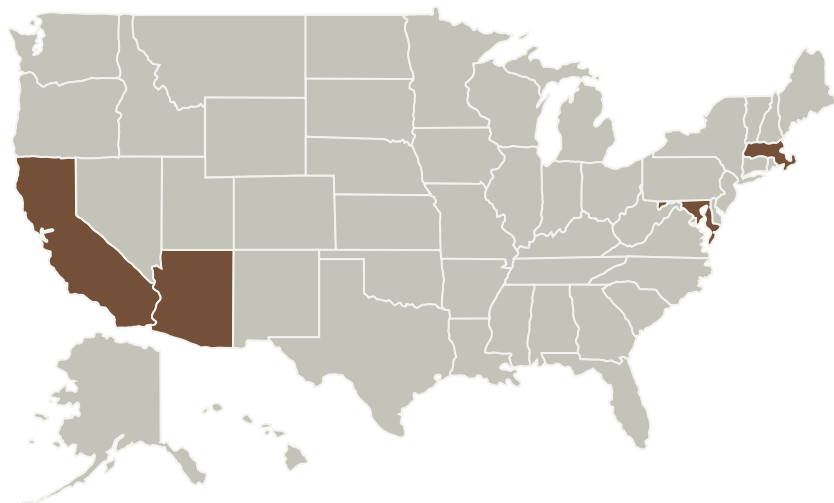
Science Mission Directorate (SMD)

### Responsible Program:

Astrophysics Research and Analysis



## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Arizona	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH), Hispanic Serving Institutions (HSI)	Tucson, Arizona

Primary U.S. Work Locations	
Arizona	California
Maryland	Massachusetts

## Project Management

### Program Director:

Michael A Garcia

### Program Manager:

Dominic J Benford

### Principal Investigator:

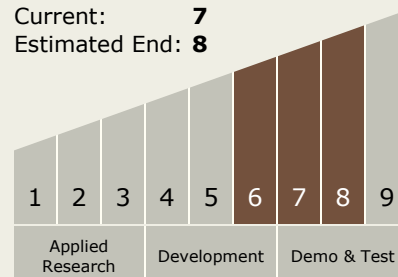
Christopher K Walker

### Co-Investigators:

Harold W Yorke  
Pietro N Bernasconi  
Jorge L Pineda Galvez  
Mark Wolfire  
Jonathan H Kawamura  
David Hollenbach  
Mary Gerrow  
Volker Tolls  
Paul F Goldsmith  
Craig A Kulesa  
Christopher E Groppi  
Gary J Melnick  
Antony A Stark  
Matthew L Ashby  
William D Langer

## Technology Maturity (TRL)

Start: 6  
Current: 7  
Estimated End: 8





## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.2 Observatories
    - └ TX08.2.3 Distributed Aperture

## Target Destination

Outside the Solar System